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Teaching Materials Based on Socio Scientific Issues: An Effective Strategy to Improve Science Literacy and Critical Thinking Skills

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Abstract: The low level of science literacy and critical thinking as well as the lack of contextual teaching materials encourage the development of more relevant and meaningful teaching materials. This study aims to analyze the effectiveness of Socio-Scientific Issues (SSI)-based teaching materials in improving students' science literacy and critical thinking skills. The study used a quasi-experimental method with a Pretest-Posttest Control Group design involving 120 students from SMPN 1 Bandar Negeri Semuong and SMPN 1 Wonosobo. Data were collected through pretests and posttests that measured science literacy and critical thinking skills, then analyzed using the Mann-Whitney test because the data were not normally distributed. The results showed that the experimental group using SSI-based teaching materials had a higher n-Gain score in both science literacy (0.71, high category) and critical thinking skills (0.71, high category) than the control group. The value of Asymp. Sig. (2-tailed) value of 0.000 indicates a significant difference between the two groups. This finding indicates that SSI-based teaching materials are effective in improving students' science literacy and critical thinking skills through the presentation of relevant socio-scientific issues that encourage analysis, evaluation, and inference. Thus, the application of SSI-based teaching materials can be an innovative strategy to improve the quality of science learning.

Keywords: Critical Thinking Skills; Quasi-Experimental; Science Literacy; Socio-Scientific Issues; Teaching Materials.

Introduction

Science education in the 21st century not only focuses on mastering concepts but also requires students to have good science literacy and critical thinking skills in dealing with real problems in everyday life. Science learning in the 21st century requires students to have various essential skills, including critical thinking, creativity, innovation, as well as problem-solving ability and technological literacy (Aisya et al., 2017). The nature of science learning includes mastering science concepts and understanding how science is used to explain natural phenomena systematically (Rahmasuci et al., 2018). However, the challenges in implementing science learning are still quite large, especially in supporting students' science literacy and critical thinking skills.

Science literacy is the ability of students to understand, evaluate and apply science concepts in everyday life (OECD, 2023). Developing science literacy in today's generation does not mean turning students into researchers, but rather equipping them with the knowledge of science and technology in order to make decisions that affect current and future survival (Ramli et al., 2022).

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Based on the results of the Program for International Student Assessment (PISA) shows that the level of science literacy of Indonesian students is still relatively low (OECD, 2019). The latest PISA data in 2022 noted that Indonesian students' science literacy score decreased from 396 in 2018 to 383, or ranked 68 out of 81 countries (OECD, 2023). Previous research also shows that students in various regions, such as Bogor, South Sumatra and Bandar Lampung, still have low science literacy achievements, especially in the aspects of understanding concepts, analyzing, and evaluating scientific information (Ardianto & Rubini, 2016; Maulina et al., 2022; Andriani et al., 2018).

In addition, students' critical thinking skills are still not optimally developed. Skills needed in the world of education in the 21st century include critical thinking skills (Fuadi et al., 2023). Critical thinking skills can be defined as the capacity to analyze, evaluate, and make decisions based on rational and logical evidence. These skills include various aspects, including in-depth analysis, interpretation, inference, and evaluation (Facione, 2015). Critical thinking skills play an important role in helping individuals solve problems they face in everyday life, especially those related to science aspects (Santika et al., 2018). Research shows that in the learning process, students tend to only memorize material without understanding, analyzing, or solving problems faced in everyday life (Insyasiska et al., 2015). Learning that is more oriented towards mastering the material causes critical thinking skills to be less trained (Hairida, 2016). One strategy that can be applied to support the habituation of science literacy and critical thinking skills of students is to implement teaching materials based on Socio-Scientific Issues (SSI). SSI introduces students to complex issues that connect science, technology and their impact on society (Nurhalimah et al., 2024). By connecting science concepts with social issues, students can develop critical thinking skills, such as analysis, evaluation, and evidence-based decision-making (Setiyadi, 2017).

The Socio-Scientific Issues (SSI) approach is seen as a potentially effective solution in overcoming these problems. Through this approach, students are encouraged to connect scientific knowledge with various relevant social issues, such as environmental pollution and public health. Based on the research results, teaching materials that apply the SSI approach are proven to be able to improve students' critical thinking skills and science literacy, because learning becomes more interesting and meaningful (Akbar et al., 2023; Suparya et al., 2022). In addition, this approach also plays a role in enriching students' understanding of the application of science in the context of everyday life.

Research conducted by Wisdayana et al., (2025), indicates that Socio-Scientific Issues (SSI)-based teaching materials have gone through a validation process with satisfactory results, both from the aspects of material, media, and language. Experts argue that this teaching material is suitable for use because it successfully integrates science concepts with relevant social contexts, making it easier for students to understand the material more deeply. In addition, the validation results also show that SSI-based teaching materials are able to encourage the development of students' critical thinking skills through issue analysis activities, group discussions, and decision making based on scientific evidence.

High validity in the development of teaching materials is very important to ensure the effectiveness of the learning process and the suitability of the material with educational objectives. High validity provides a quality learning experience, in line with the following (Mila, 2023), which states that E-module research developed with high validity in all aspects of content and graphic design provides a quality learning experience.

While SSI-based teaching materials have been widely studied theoretically, their implementation in the field is still limited, especially in the form of printed modules in junior high school science learning. Previous research generally focused on product validation and small-scale trials, without an in-depth study of the effectiveness of widespread implementation in schools and its effect on improving students' science literacy and critical thinking skills. Therefore, this study was conducted to fill the gap by examining the extent to which SSI-based teaching materials are effective in improving both aspects in real classrooms.

Method

This study applied the quasi-experiment method using the Pretest-Posttest Control Group Design. The design involved two groups, namely the experimental group that received treatment in the form of applying SSI-based teaching materials and the control group that received learning with conventional teaching materials. Measurements were taken twice, namely before (pretest) and after treatment (posttest), with the aim of analyzing differences in improving science literacy and critical thinking skills between the two groups. The population of this study were all grade VIII students at SMPN 1 Bandar Negeri Semuong (BNS) and SMPN 1 Wonosobo, Tanggamus Regency, Lampung. The sample selection was conducted using cluster random sampling technique. This research was conducted in class VIII A and VIII D as many as 120 students.

Data analysis techniques were quantitative and qualitative. Quantitative data were obtained from pretest and posttest results that measured students' science literacy and critical thinking skills, with the aim of evaluating the effectiveness of teaching materials applied as well as students' responses to the use of SSI-based teaching materials.

The validity of the pretest and post-test question instruments uses content validity through the Aiken v test, following the Aiken v Test formula.

$$V = \frac{\sum S}{n(C-1)} \quad (1)$$

Description:
V = Aiken's item validity index
S = the score given by each rater after deducting the lowest score in the category,
n = number of raters
c = number of categories that can be selected by the rater.

The results of the Aiken V index calculation can be classified based on the value obtained, which is 0 to 1. The index categories can be seen in Table 1.

Tabel 1. Aiken V Index Criteria

Index	Criteria
0,8 –1	Very high validity
0,6 – 0,79	High validity
0,40 – 0,59	Medium validity
0,20 – 0,39	Low validity
0,00 – 0,19	Very valid

Source: Adaptation (Retnawati, 2016)

Data from pre-test and post-test results were analyzed using n-Gain to measure the increase in effectiveness more specifically. N-Gain is the difference between pretest and posttest scores. The n-Gain test was used to avoid bias in the study by using the formula:

$$\text{n-Gain} = \frac{\text{Posttest score} - \text{Pretest score}}{\text{Maximum score} - \text{Prettes score}} \quad (2)$$

With categories:
G = high : G value ≥ 0.70
G = melium : value 0.30 ≤ G ≤ 0.70
G = low : G value < 0.30

After obtaining n-Gain, parametric or nonparametric tests were carried out, this test was carried out with SPSS software (Widana & Muliani, 2020). Meanwhile, data from the questionnaire was analyzed descriptively qualitatively to describe the responses of educators and students to the use of SSI-based teaching materials.

The hypothesis of this study is as follows:
H0: There is no difference in effectiveness between the use of SSI-based teaching materials in control and experimental classes.
H1: There is a difference in effectiveness between the use of SSI-based teaching materials in the control and experimental classes.

If the significance value > 0.05, then H0 is accepted, which means there is no difference in the average effectiveness of using SSI-based teaching materials between the control and experimental classes. Conversely, if the significance value ≤ 0.05, then H0 is rejected, which indicates that there is a difference in the effectiveness of using SSI-based teaching materials in the two classes.

For student response scores to the teaching materials used are presented in Table 2.

Table 2. Student Response Categories

Percentage (%)	Category
80%-100%	Very good
70-79%	Good
60%-69%	Medium
50%-59%	Less
0%-49%	Very less

Source: Arikunto, 2016

The research instrument consisted of a description test for literacy (indicators of science content, science process and science context) and critical thinking skills (indicators of interpretation, analysis, evaluation and inference). The pretest and posttest instrument grids are presented in Table 3.

Table 3. Pretest and Posttest Instrument Grids

Learning Objectives	Science Literacy Indicators	Critical Thinking Indicators	Shape	Question No	Total
Understand the process of the greenhouse effect	Science process	Inferensi	Essay	2a 4 6a	3
Analyze the causes and effects of the greenhouse effect	Science content Science context		Essay	2b,6b 2c, 6c	4
Analyze the causes of global warming			Essay	5a 1a,	3

Learning Objectives	Science Literacy Indicators	Critical Thinking Indicators	Shape	Question No	Total
Analyze the impact of global warming	Science process	Interpretation Inference Evaluation Analysis	Essay	1b 3 5b 7a	3
Identify efforts to control global warming		Evaluation Inference	Essay	5c 7b	2
Number of questions					15

Result and Discussion

Result

The results of this application showed significant value. The pretest and post-test scores showed a significant increase in students' science literacy and critical thinking skills. This improvement can be seen from the achievement of science literacy indicators. Figure 1. shows the comparison of the n-Gain value of science literacy between the control class and the experimental class based on three indicators, namely science process, science content, and science context. N-Gain is used to measure the improvement of students' understanding after learning by comparing pretest and posttest results.

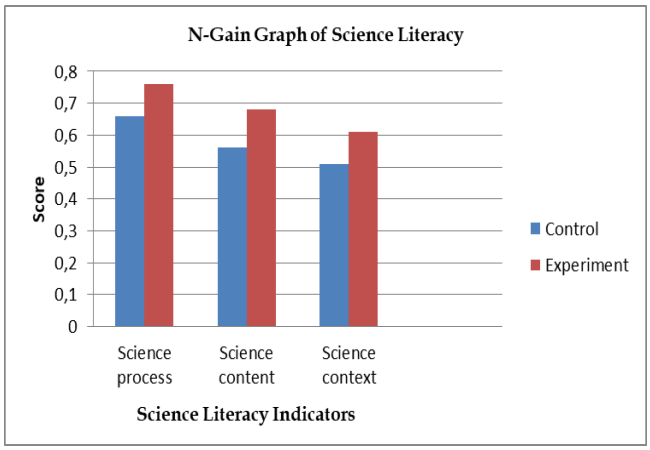

Figure 1. N-Gain Graph of Science Literacy

Based on Figure 1 n-Gain of science literacy, it can be seen that the experimental class experienced a higher increase than the control class in all science literacy indicators. In the science process indicator, the experimental class achieved the highest score, indicating that the approach used was effective in training students to understand and apply the scientific process. A significant increase was also seen in the science content and science context indicators, indicating that students' understanding of the material and its application in everyday contexts is getting better. Figure 2 shows a comparison of the n-Gain scores of critical thinking skills between the control and experimental classes based on four indicators, namely interpretation, analysis, evaluation, and inference.

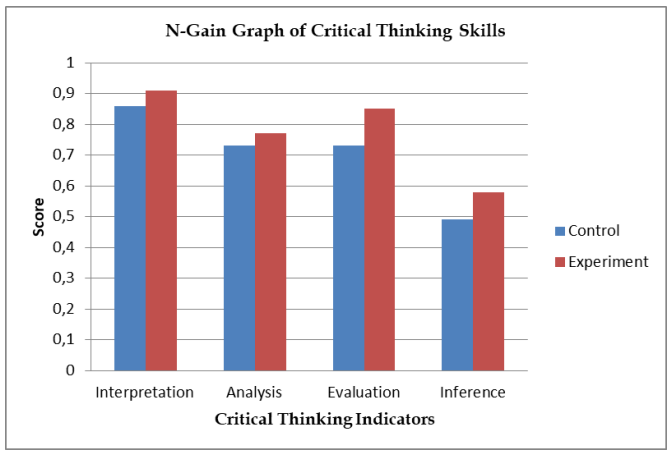

Figure 2. N-Gain Graph of Critical Thinking Skills

Based on Figure 2 n-Gain of critical thinking skills, it can be seen that the experimental class experienced a higher increase than the control class in all indicators. The interpretation indicator shows the highest score in the experimental class, indicating that students' ability to understand and interpret information has increased significantly. In addition, a fairly high increase was also seen in the evaluation, analysis and inference indicators also experienced a significant increase in the experimental class compared to the control class.

The results of the effectiveness test of teaching materials in improving students' science literacy and critical thinking skills were carried out through a series of statistical tests including normality test, homogeneity test, and nonparametric test using Mann-Whitney Test, considering that the data obtained were not normally distributed. Table 3. presents the results of the Mann-Whitney test on students' science literacy at SMPN 1 Bandar Negeri Semuong and SMPN 1 Wonosobo based on the n-Gain value. This test is used to determine whether there is a significant difference between the two groups being compared.

Table 4. Mann-Whitney Test Results of science literacy at SMPN 1 Bandar Negeri Semuong and SMPN 1 Wonosobo

	n-Gain
Mann-Whitney U	565.000
Wilcoxon W	2395.000
Z	-6.524
Asymp. Sig. (2-tailed)	.000

a. Grouping Variable: Kelas

Based on Table 3 of the Mann-Whitney test results, the significance value of Asymp. Sig. (2-tailed) significance value is 0.000, which is smaller than 0.05. Thus, the null hypothesis (H0) is rejected, which means there is a statistically significant median difference between the two groups on the n-Gain variable. From the average n-Gain results in the control class of 0.59 (medium category) while in the experimental class 0.71 (high category). These results indicate that the teaching materials developed are effective in improving students' science literacy.

Table 4. presents the results of the Mann-Whitney test on students' critical thinking skills at SMPN 1 Bandar Negeri Semuong and SMPN 1 Wonosobo. based on the n-Gain value. This test is used to determine whether there is a significant difference between the two groups being compared.

Table 5. Mann-Whitney Test Results of critical thinking skills at SMPN 1 Bandar Negeri Semuong and SMPN 1 Wonosobo

	n_Gain
Mann-Whitney U	737.000
Wilcoxon W	2567.000
Z	-5.608
Asymp. Sig. (2-tailed)	.000

a. Grouping Variable: Kelas

Based on the Mann-Whitney test results, in Table 4, the significance value of Asymp. Sig. (2-tailed) is 0.000, which is smaller than 0.05. Thus, the null hypothesis (H0) is rejected, which means there is a statistically significant median difference between the two groups on the n-Gain variable. From the average n-Gain results in the control class of 0.62 (medium category) while in the experimental class 0.71 (high category). These results indicate that the developed teaching materials are effective in improving students' critical thinking skills in understanding science concepts better.

Figure 3 presents a graph of student response scores used to evaluate student responses to the developed teaching materials. This assessment includes three main aspects, namely the appearance, presentation of material, and the benefits of teaching materials. Based on the results of the analysis, the highest score is in the benefits aspect, indicating that the teaching materials are considered to make a positive contribution in supporting the learning process. The material presentation aspect also scored quite high, while the display aspect had the lowest score, indicating the need for further development in the visualization of teaching materials.

The results for student responses can be seen in Figure 3 below, which presents data regarding the validity level of teaching materials based on student opinions. This analysis aims to assess the extent to which the teaching materials developed are in accordance with the needs and understanding of students.

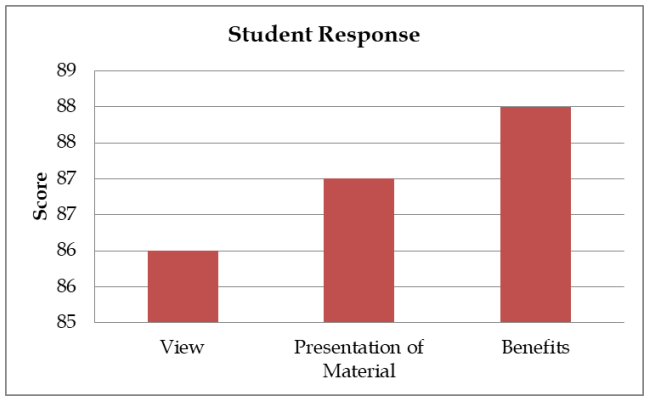

Figure 3. Student Response Graph

Based on Figure 3, the average score for the display aspect is 0.86 in the "very high" category, the material presentation aspect is 0.87 in the "very high" category, and the benefit aspect is 0.88 in the "very high" category. These results show that from the three aspects of student responses, it shows that the SSI-based teaching materials that have been developed, in general, are considered suitable for use as teaching materials to improve students' science literacy and critical thinking skills. Students also provided input on some terms that are not yet in the glossary. In response, improvements have been made to improve the quality of the module to make it more suitable for use as teaching materials.

Discussion

The results showed that the experimental group using teaching materials based on Socio-Scientific Issues (SSI) experienced a significant increase in science literacy and critical thinking skills when compared to the control group using conventional teaching materials. The increase can be explained by the characteristics of SSI-based teaching materials that emphasize complex social issues and are relevant to real life, thus encouraging students to think critically, analyze information in depth, and make decisions based on scientific understanding. This SSI-based teaching material uses

dilemmatic social issues related to science and is equipped with pictures, materials, and learning activities that can create a more enjoyable learning atmosphere for students (Ma'rufah et al., 2021).

Research by Zeidler et al., (2019), revealed that the SSI-based approach is effective in improving science literacy, because students are invited to understand science concepts in a context that is directly related to everyday life. In addition, discussions on socio-scientific issues are proven to develop students' critical thinking skills, such as the ability to interpret, analyze, evaluate, and infer. This is in line with the findings of Hidayati & Aulia, (2024), who stated that the application of the Socio-Scientific Issues (SSI) approach in education provides a number of important benefits that can improve students' ability to solve problems.

The application of the SSI approach is effective in improving students' science literacy (Khikmah et al., 2024). This strategy allows students to connect science knowledge with real social issues, so that they not only understand science concepts theoretically, but are also able to apply them in rational decision making. This finding is also supported by research (Santika et al., 2018), showed that the use of locally relevant issues in teaching materials can strengthen students' science literacy because they are more motivated to learn material that is directly related to their lives. The increased effectiveness of teaching materials as learning media is in line with research findings (Rostikawati & Permanasari, 2016), which revealed that the use of SSI-based teaching materials can significantly improve students' science literacy.

Research on the effect of the SSI approach on students' scientific literacy has been conducted, among others, by (I. D. Rahayu et al., 2022; Rubini et al., 2019; Saija et al., 2022). The three opinions conclude that the application of the Socio-Scientific Issues (SSI) approach can effectively improve students' science literacy. Rubini emphasized that the integration of SSI in Problem Based Learning makes it easier for students to understand scientific phenomena. Rahayu argues that SSI-based teaching materials connected to the Elsmawar website are able to support science literacy according to 21st century skills. Meanwhile, Saija states that SSI-based OE3C learning is effective in deepening students' understanding of scientific principles relevant to everyday life. In line with research conducted by (Sulistina et al., 2024) which states that SSI-based learning can improve students' science literacy in implementing socio-scientific knowledge in life.

In line with the research conducted by (Septiningrum et al., 2021) which states that the use of teaching materials based on Socio-Scientific Issues (SSI) is proven effective for improving students' critical thinking skills, as indicated by the significant difference in the n-gain results of the control class science literacy variable of 0.59 and 0.71 experiment. While for the critical thinking skills variable in the control class showed 0.62 and the experimental class 0.71.

The SSI approach in science learning has an impact on student skills including scientific literacy skills, critical thinking skills, scientific argumentation skills, and mastery of student concepts (Nurhalimah et al., 2024). Another study also confirmed that the application of SSI-based IPAS learning affects students' critical thinking skills (Nubita & Istianah, 2022). The SSI-based science learning approach is able to support students in understanding various socio-scientific issues that are directly related to everyday life (Yuliastini dan Rahayu, 2016; Rohmawati et al., 2018). Overall, these results indicate that the use of SSI-based teaching materials can improve students' science literacy more effectively than conventional methods.

Based on the n-Gain results, critical thinking skills need to be improved on the analysis and inference indicators. The low ability to analyze can be influenced by the limited experience of students in identifying relevant information, comparing data, and evaluating arguments comprehensively. The results of the above study are in line with research (Hidayati & Aulia, 2024), which states that the application of SSI in science learning plays a role in improving the ability to analyze and evaluate scientific information. The low inference ability can be influenced by limited training in drawing conclusions from implicit data and connecting diverse information logically and systematically. Another study stated that the n-Gain results on the indicators of students' critical thinking skills still need serious attention, especially on the evaluation and inference indicators which show low achievement (S. Rahayu, 2019).

The SSI approach not only strengthens science literacy but also hones students' critical thinking skills. Through this approach, students are trained to critically assess scientific information and make decisions based on in-depth analysis of various socio-scientific issues (I.N. Selamat, 2021). According to Zeidler et al. (2019), the SSI-based approach is effective in developing students' critical thinking skills because it involves them in analyzing and evaluating complex socio-scientific issues that are relevant to everyday life. Based on the discussion, SSI-based teaching materials can be an innovative solution in improving students' science literacy and critical thinking skills.

While this study shows that SSI-based teaching materials are effective in improving students' science literacy and critical thinking skills, there are some limitations that need to be considered. First, this study

was only conducted in two schools in Tanggamus district, so the results cannot be widely generalized to school contexts with different characteristics, such as schools in urban areas, private schools, or schools with limited resources. Second, the intervention using SSI-based teaching materials focused on one topic, global warming. This may limit the understanding of the effectiveness of the SSI approach on other science topics or subjects that have different content characteristics. Third, the evaluation of the effectiveness of teaching materials was carried out in the short term through pretests and posttests. The results of this study have not revealed the long-term impact on changes in critical thinking and the level of science literacy of students in a sustainable manner

Conclusion

The results of this study indicate that SSI-based teaching materials can significantly improve students' science literacy and critical thinking skills. The average n-Gain score of science literacy (0.71, high category) and the average n-Gain of critical thinking skills (0.71, high category) which were higher in the experimental group than the control group indicated the effectiveness of the integration of socio-scientific issues in science learning. The use of SSI-based teaching materials not only deepens the understanding of science concepts, but also encourages learners to critically analyze, evaluate, and make inferences. Therefore, the SSI-based learning approach can be a valuable pedagogical strategy to develop essential skills needed in 21st century education.

The practical implication of this finding is that teachers can adapt the SSI approach in lesson planning to build linkages between science concepts and real issues in society. For schools, the results support the importance of curriculum development and provision of teaching materials that encourage critical thinking and science literacy based on local and global contexts. Future research is recommended to explore the long-term impact of SSI-based learning in various educational contexts and develop more diverse SSI resources to support science learning.

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Conflicts of Interest
The authors declare that there is no conflict of interest in this study.

References

Aisya, Naafi Wibowo, Y., & Aminatun, T. (2017). The Influence Of Socio-Scientific Issues On Reflective Judgment Of High School's Student In Ecosystem Material. *Jurnal Bioedukatika*, *4*(2), 14. https://doi.org/10.26555/bioedukatika.v4i2.5346

Akbar, A., Zain, Z., & Nugroho, A. (2023). Pendampingan Literasi Sains Dalam Implementasi Kurikulum Merdeka Yayasan Uswatun Hasanah Bontang. *Jurnal Pengabdian Masyarakat*, *1*(2), 44–51. https://doi.org/10.59562/abdimas.v1i2.1017

Andriani, N., Saparini, S., & Akhsan, H. (2018). Kemampuan Literasi Sains Fisika Siswa SMP Kelas VII Di Sumatera Selatan Menggunakan Kerangka PISA (Program for International Student Assesment). *Berkala Ilmiah Pendidikan Fisika*, *6*(3), 278. https://doi.org/10.20527/bipf.v6i3.5288

Ardianto, D., & Rubini, B. (2016). Comparison of students' scientific literacy in integrated science learning through model of guided discovery and problem based learning. *Jurnal Pendidikan IPA Indonesia*, *5*(1), 31–37. https://doi.org/10.15294/jpii.v5i1.5786

Facione, P. a. (2015). Critical Thinking : What It Is and Why It Counts. In *Insight assessment* (Issue ISBN 13: 978-1-891557-07-1.). https://www.insightassessment.com/CT-Resources/Teaching-For-and-About-Critical-Thinking/Critical-Thinking-What-It-Is-and-Why-It-Counts/Critical-Thinking-What-It-Is-and-Why-It-Counts-PDF

Fuadi, A., Nasution, W. N., & Wijaya, C. (2023). Management of Teacher Professionalism Development: A Multi-Site Study of State Madrasah Aliyah in Langkat Regency. *Tafkir: Interdisciplinary Journal of Islamic Education*, *4*(1), 180–199. https://doi.org/10.31538/tijie.v4i1.444

Hairida, H. (2016). The effectiveness using inquiry based natural science module with authentic assessment to improve the critical thinking and inquiry skills of junior high school students. *Jurnal Pendidikan IPA Indonesia*, *5*(2), 209–215. https://doi.org/10.15294/jpii.v5i2.7681

Hidayati, S. N., & Aulia, E. V. (2024). *Penerapan Socio Scientific Issues (SSI) untuk Meningkatkan Kemampuan Pemecahan Masalah Peserta Didik Kelas*

VII di Era. *4*(4).

I.N. Selamat. (2021). Keterampilan Abad Ke-21 Pada Pembelajaran Sains Dengan Konteks Socio-Scientific Issues Di Indonesia: Tinjauan Literatur Sistematis. *Jurnal Pendidikan Dan Pembelajaran IPA Indonesia*, *11*(2), 14–21. https://doi.org/10.23887/jppii.v11i2.60895

Ika Budi Yuliastini, Sri Rahayu, F. F. (2016). *POGIl Berkonteks Socio Scientific Issues (SSI) dan Literasi Sains Siswa SMK*.

Insyasiska, D., Zubaidah, S., & Susilo, H. (2015). Pengaruh Project Based Learning Terhadap Motivasi Belajar , Kreativitas , Kemampuan Berpikir Kritis , dan Kemampuan Kognitif Siswa pada Pemebelajaran Biologi. In *Jurnal Pendidikan Biologi* (Vol. 7, Issue 1, pp. 9–21).

Mamba'ul Khikmah, Elok Sudibyo, R. W. M. (2024). *EFektivitas Pendekatan Socio-Scientific Issues (SSI) Pada Materi Pencemaran Lingkungan Untuk Meningkatkan Literasi Sains Siswa SMP*. Jurnal Penelitian dan Pembelajaran MIPA.pdf.

Maulina, D., Widyastuti, Maulina, H., & Mayasari, S. (2022). Kajian Faktor Intrinsik Dan Kemampuan Literasi Sains Siswa Smp Di Kota Bandar Lampung. *LENSA (Lentera Sains): Jurnal Pendidikan IPA*, *12*(1), 1–8. https://doi.org/10.24929/lensa.v12i1.201

Mila, M. R. (2023). *ELSE (Elementary School Education Journal) Analisis Validitas Bahan Ajar Elektronik Materi Elemen Pancasila Menggunakan Pendekatan Value Clarification Technique Model Matriks di SD*. *7*(2), 179–185. https://journal.um-surabaya.ac.id/index.php/pgsd

Muhimmatun Ma'rufah, D., Ngabekti, S., & Setiati, N. (2021). Development of Socioscientific Issues-Based Teaching Materials to Improve Learning Outcomes and Students' Environment Careness on The Environmental Changing Material. *Journal of Innovative Science Education*, *9*(3), 87–94. https://doi.org/10.15294/jise.v9i2.39911

Mustika Rahmasuci, Husnul Hotimatus S, M. A., & Putri Wulandari, Diah Adistia A, S. B. (2018). *View of Strategi Menemukan Jalan Keluar Labirin dengan Waktu Tercepat Menggunakan Metode DFS.pdf*. Informatics Journal.

Neli Wisdayana, Achyani, Arif Rahman Aththibby, D. P. (2025). Integrasi Literasi Sains pada Bahan Ajar Berbasis Socio Scientific Issue. *Jurnal Pendidikan*, *15*(Maret), 40–50. https://doi.org/10.37630/jpm.v15i1.2164

Nubita, A. R., & Istianah, F. (2022). Pengaruh Pembelajaran Berbasis Socio Scientific Issues Terhadap Kemampuan Berpikir Kritis Siswa Kelas V Sekolah Dasar. *Jpgsd*, *12*(4), 707–716.

Nurhalimah, S., Latip, A., & Purnamasari, S. (2024). Analisis Pendekatan Socio-Scientific Issues (Ssi) DalamPembelajaran Ipa Terhadap Literasi Saintifik. *Jurnal Ilmiah Pendidikan Dasar*, *9*(2), 1987–2000.

OECD. (2019). PISA 2018 Results (Online). In *Pisa: Vol. I*. https://www.oecd.org/pisa/publications/

OECD. (2023). PISA 2022 Results. In *Factsheets: Vol. I*. https://www.oecd-ilibrary.org/education/pisa-2022-results-volume-i_53f23881-en%0Ahttps://www.oecd.org/publication/pisa-2022-results/country-notes/germany-1a2cf137/

Rahayu, I. D., Permanasari, A., & Heliawati, L. (2022). The Effectiveness of Socioscientific Issue-Based Petroleum Materials Integrated with The Elsmawar Website on Students' Scientific Literacy. *Journal of Innovation in Educational and Cultural Research*, *3*(2), 279–286. https://doi.org/10.46843/jiecr.v3i2.118

Rahayu, S. (2019). Socioscientific Issues : Manfaatnya dalam Meningkatkan Pemahaman Konsep Socioscientific Issues : Manfaatnya dalam Meningkatkan Pemahaman Konsep Sains , Nature of Science (NOS) dan Higher Order Thinking Skills (HOTS). *Seminar Nasional Pendidikan IPA UNESA*, *October*, 2.

Ramli, M., Susanti, B. H., Yohana, M. P., Sciences, T., Islam, U., Syarif, N., Jakarta, H., & Selatan, T. (2022). *Indonesian Students' Scientific Literacy in Islamic Junior High School*. *2*(1), 45–52.

Retnawati, H. (2016). *Analisis Kuantitatif Instrumen Penelitian*. Parama Publishing.

Rohmawati, E., Widodo, W., & Agustini, R. (2018). Membangun Kemampuan Literasi Sains Siswa Melalui Pembelajaran Berkonteks Socio-Scientific Issues Berbantuan Media Weblog. *Jurnal Penelitian Pendidikan IPA*, *3*(1), 8. https://doi.org/10.26740/jppipa.v3n1.p8-14

Rostikawati, D. A., & Permanasari, A. (2016). Rekonstruksi bahan ajar dengan konteks socio-scientific issues pada materi zat aditif makanan untuk meningkatkan literasi sains siswa. *Jurnal Inovasi Pendidikan IPA*, *2*(2), 156. https://doi.org/10.21831/jipi.v2i2.8814

Rubini, B., Ardianto, D., Setyaningsih, S., & Sariningrum, A. (2019). Using Socio-scientific Issues in Problem Based Learning to Enhance Science Literacy. *Journal of Physics: Conference Series*, *1233*(1). https://doi.org/10.1088/1742-6596/1233/1/012073

Saija, M., Rahayu, S., Fajaroh, F., & Sumari. (2022). Enhancement of High School Students' Scientific Literacy Using Local-Socioscientific Issues in Oe3C Instructional Strategies. *Jurnal Pendidikan IPA Indonesia*, *11*(1), 11–23.

https://doi.org/10.15294/jpii.v11i1.33341

Santika, A. R., Purwianingsih, W., & Nuraeni, E. (2018). Analysis of students critical thinking skills in socio-scientific issues of biodiversity subject. *Journal of Physics: Conference Series*, *1013*(1). https://doi.org/10.1088/1742-6596/1013/1/012004

Septiningrum, D., Khasanah, N., & Khoiri, N. (2021). Development of Biology Teaching Materials of Virus Based on Socio- Scientific Issues (SSI) to Improve Student ' s Critical Thinking Ability Pengembangan Bahan Ajar Biologi Materi Virus Berbasis Socio- Scientific Issues (SSI) untuk Meningkatkan Kemampu. *Jurnal Phenomenon*, *11*(1), 87–104.

Setiyadi, M. W. (2017). Pengembangan Modul Pembelajaran Biologi Berbasis Pendekatan Saintifik Untuk Meningkatkan Hasil Belajar Siswa. *Journal of Educational Science and Technology (EST)*, *3*(2), 102. https://doi.org/10.26858/est.v3i2.3468

Suharsimi Arikunto. (2016). *Prosedur Penelitian Suatu Pendekatan Praktik*. Jakarta: Rineka Cipta.

Sulistina, O., Purwandari, A., Deaningtyas, S. A., Putrikundia, S. A., & Faradillah, N. I. (2024). Peran Pendekatan Socio-Scientific Issue (Ssi) Dalam Meningkatkan Scientific Literacy Pada Pembelajaran Kimia. *UNESA Journal of Chemical Education*, *13*(2), 118–128. https://doi.org/10.26740/ujced.v13n2.p118-128

Suparya, I. K., I Wayan Suastra, & Putu Arnyana, I. B. (2022). Rendahnya Literasi Sains: Faktor Penyebab Dan Alternatif Solusinya. *Jurnal Ilmiah Pendidikan Citra Bakti*, *9*(1), 153–166. https://doi.org/10.38048/jipcb.v9i1.580

Widana, W., & Muliani, P. L. (2020). Buku Uji Persyaratan Analisis. In *Analisis Standar Pelayanan Minimal Pada Instalasi Rawat Jalan di RSUD Kota Semarang*.

Zeidler, D. L., Herman, B. C., & Sadler, T. D. (2019). New directions in socioscientific issues research. *Disciplinary and Interdisciplinary Science Education Research*, *1*(1). https://doi.org/10.1186/s43031-019-0008-7